CLOSURES AND CONTAINERS IN COMBINATION THEREWITH

The present invention relates to the packaging of fluids and, in particular, to closures for containers in which the closure is capable of providing resealable access to the contents of the container.

In the specification which follows the problems of fluid packaging will be discussed with particular reference to the problems associated with the packaging of milk. However, it will be appreciated that other potable fluids such as water and fruit juices present similar packaging problems.

Conventionally, milk has been packaged in blow-moulded plastics containers which are provided with resealable caps. The resealable caps are typically formed of injection moulded plastics material. There is however, a fundamental problem in achieving a good seal between a blow-moulded plastics container and an injection moulded plastics cap. This is because the tolerance of the neck of the container may be of the order of ± 0.3mm whereas the tolerance of an injection moulded item, such as the cap, is typically ± 0.1mm. This means that it is inevitable that a proportion of the caps made to a particular specification will not seal tightly when fitted to the necks of the containers for which they are intended. This in turn leads to production difficulties in applying the caps to the container necks and leakage problems for both retailers and distributors of the packaged product.

This problem is further exacerbated by the fact that the blow-moulded plastics containers are typically manufactured at a different location and by a different producer from the injection moulded plastics caps. This is because, although the containers could be supplied to the bottling plant ready made, this would inevitably result in the need

to transport large volumes. It is therefore more usual for the blow-moulded containers to be produced in a blow-moulding plant adjacent the dairy so that they can be formed and filled on one continuous production line.

However, the consequence of having two parts, the container and the cap, which must co-operate if there is to be an adequate seal, manufactured by different parties and at different locations means that on those occasions when the sealing characteristics of a batch of containers is poor there is also a lack of accountability as to which of the container or the cap is responsible.

In order to address the problems of leakage, there have in recent years been proposed a large number of different designs of cap. For example, in one design, the cap is provided with a top and a downwardly extending skirt portion which depends from the top. The skirt portion is provided on an inner surface with one or more threads for engagement with one or more complimentary threads provided on an outer surface of the container neck. A downwardly depending annular plug is provided on an underside of the top, spaced radially inwardly of the skirt. The plug is dimensioned to engage a rim of the container opening defined by the neck so as to form a primary seal. A secondary seal may be provided by means of an annular bead or shoulder provided on the cap at or adjacent the intersection of the top and the depending skirt such that, upon application of the cap to the container neck, the bead or shoulder engages an external surface of the neck at a location above the threads. However, although commercially successful, this design of cap does not adequately address the fundamental problem of providing a reliable seal between a blow-moulded component and an injection moulded component. Instead, leakage rates have been

reduced by providing ever increasing numbers of primary, secondary and sometimes even tertiary sealing surfaces. However, on occasion, the provision of so many seals can be counter productive and actually cause leakage rates to rise as the interrelated tolerances of the cap and neck result in clashes between the sealing surfaces.

Another design of closure is described in GB-A-2,374,068. In this document there is proposed a container comprising a blow-moulded plastics body and an injection moulded neck and cap assembly which can be fused to the body after the body has been filled with a fluid. In other words, the closure to the container comprises two parts, a neck and a cap, both of which may be injection moulded to the same tolerances. This enables the cap and neck, by virtue of their mutual cooperation, to provide a plurality of reliable sealing surfaces. At the same time, the injection moulded neck is permanently adhered to the blow-moulded plastics body so as to prevent any leakage between the two.

Initially, the injection moulded neck is formed with a membrane with which to close off the opening in the blow-moulded plastics body. However, this membrane may be removed and discarded by pulling on a pull-ring with which the membrane is provided. This allows access to be gained to the contents of the blow-moulded plastics body while the resealing capability of the closure is provided by the engagement of an annular plug provided on an underside of the cap with the bore of the injection moulded neck.

This two part closure design clearly has the potential to provide improved sealing characteristics. However, the use of the described injection moulded neck inevitably adds to the height of the packaged product as well as to the radial dimensions of the cap

with which it must interengage. As a result, the use of such a closure necessitates the use of a dedicated bottling line which is adapted to handle containers of a non-standard height. Likewise, the use of a non-standard cap requires the adaptation of existing capping equipment. All this imposes a considerable burden on those responsible for the bottling plant and acts as a disincentive in moving from one design of closure to another despite the anticipated improvement in sealing characteristics that can be expected to result.

Therefore, although it is known to overcome the difficulties associated with providing a reliable resealable closure by abandoning the previous attempt to design an injection moulded cap capable of sealingly engaging with a blow-moulded container and replacing it with a two part assembly, both parts of which may be injection moulded with one part permanently adhered to the still blow-moulded container and the other part providing resealable engagement with the first part, nevertheless the problem of providing such an assembly which is capable of being applied using existing capping equipment still remains.

In particular, it would be desirable to provide a two part assembly which is capable of being used with a container having a standard silhouette and being of a conventional height. In this way there would be no need for the various stations on a bottling line to be specially adapted to accommodate a different shape or height of bottle. Likewise, it would also be desirable to provide a two part assembly in which the external dimensions of the cap, known as the cap silhouette, were the same as an existing industry standard. In this way, the two part assembly could be used with existing "pick and place" equipment and with existing capping machines, thereby removing the need

for the bottling line to move over to new or different equipment simply to process a batch of containers having a different and otherwise highly desirable closure system. The present invention seeks to address these desires.

According to a first aspect of the present invention there is provided a closure for use with a container neck, the closure comprising a cap and an insert, the insert being adapted to be permanently adhered to the container neck and having a sealing surface and the cap comprising a complimentary sealing surface for sealable engagement with the sealing surface provided on the insert and engagement means for releasable engagement with complimentary engagement means provided on the container neck.

Advantageously the container neck may have a rim surrounding an axial bore and the insert may be adapted to be received within the bore, the insert having a flange adapted to project outwardly from the bore to overlie the surrounding rim such that the insert protrudes axially from the bore no more than the thickness of the flange. This provides the advantage of restricting the height of the insert above the container neck and so permits the use of a conventionally dimensioned cap.

Advantageously the container neck may have an external neck surface and the insert may be shaped such that no part of the insert overlies the external neck surface. This provides the advantage of restricting the dimensions of the insert in a plane perpendicular to the axis of the bore and so once again permits the use of a conventionally dimensioned cap.

According to a second aspect of the present invention there is provided a closure for use with a container neck, the container neck having a rim surrounding an axial bore and the closure comprising a

cap and an insert, the cap having a sealing surface and the insert being adapted to be received within the bore and permanently adhered to the container neck and having a complimentary sealing surface for sealable engagement with the sealing surface provided on the cap and a flange, the flange being adapted to project outwardly from the bore to overlie the surrounding rim such that the insert protrudes axially from the bore no more than the thickness of the flange. This again provides the advantage of restricting the height of the insert above the container neck and so permits the use of a conventionally dimensioned cap.

Advantageously the cap may be provided with engagement means for releasable engagement with complimentary engagement means provided on the container neck.

Advantageously the container neck may have an external neck surface and the insert may be shaped such that no part of the insert overlies the external neck surface. This again provides the advantage of restricting the dimensions of the insert in a plane perpendicular to the axis of the bore and so once more permits the use of a conventionally dimensioned cap.

According to a third aspect of the present invention there is provided a closure for use with a container neck having an external neck surface, the closure comprising a cap and an insert, the cap having a sealing surface and the insert having a complimentary sealing surface for sealable engagement with the sealing surface provided on the cap, the insert being adapted to be permanently adhered to the container neck and shaped such that no part of the insert overlies the external neck surface. This again provides the advantage of restricting the dimensions of the insert in a plane perpendicular to the axis of a bore defined by the container neck and so once more permits the use of a conventionally dimensioned cap.

Advantageously the cap may be provided with engagement means for releasable engagement with complimentary engagement means provided on the container neck.

Advantageously the container neck may have a rim surrounding an axial bore and the insert may be adapted to be received within the bore, the insert having a flange adapted to project outwardly from the bore to overlie the surrounding rim such that the insert protrudes axially from the bore no more than the thickness of the flange. This again provides the advantage of restricting the height of the insert above the container neck and so once more permits the use of a conventionally dimensioned cap.

Advantageously the cap may comprise a top and a depending side wall, the engagement means being provided on an interior surface of the depending side wall. Advantageously the engagement means may comprise a helical thread configuration. Alternatively the engagement means may comprise a first formation adapted to be snapped over and held in position by a second retaining formation provided on the container neck.

Advantageously the bore may be cylindrical and the flange may be adapted to project radially outwardly from the bore. Advantageously the external dimension of the flange may be less than that of the rim it is adapted to overlie. Advantageously the flange may incorporate a pour lip. Advantageously the flange may be adapted to be permanently adhered to the container neck. Advantageously an undersurface of the flange may incorporate a recess for the receipt of a sealing medium with which to permanently adhere the insert to the container neck.

Advantageously the insert may be adapted to be wholly received within the external dimensions of the cap. Advantageously the cap may have the same

silhouette as that of a conventional cap thereby enabling the closure to be applied using existing capping equipment.

Advantageously the container neck may define a bore and the insert may comprise a wall adapted to be received within the bore, an interior surface of the wall defining the sealing surface provided on the insert and an exterior surface of a plug provided on the cap defining the complimentary sealing surface provided on the cap. Preferably the bore and wall are cylindrical and the plug provided on the cap is annular.

Advantageously the insert may be provided with a removable membrane with which to close off the container neck. Preferably the removable membrane may be at least in part defined by a frangible line of weakness and may be provided with a pull-ring with which to separate the membrane from the remainder of the insert. Advantageously at least a portion of the removable membrane may be concave.

Advantageously both the cap and the insert may comprise injection moulded plastics components.

According to a fourth aspect of the present invention there is provided a closure in combination with a container having a container neck, the closure being as previously described. Advantageously the container and container neck may be of a conventional design thereby enabling the container to be manipulated on a production line using existing equipment.

According to a fifth aspect of the present invention there is provided a closure in combination with a container having a container neck defining a bore, the closure comprising a cap and an insert, the insert being permanently adhered to the container neck and comprising a wall received within the bore and the cap comprising a plug which sealingly engages with an

interior surface of said wall at a location within the container neck. This provides the advantage of enabling the strength of the container neck to contribute towards the adequacy of the seal.

Advantageously, at the location of sealing engagement, the wall of the insert may be interposed between the plug and a surface of the container neck defining the bore. Advantageously the plug may be formed so as to not only sealingly engage with an interior surface of the wall but also to urge an external surface of the wall into sealing engagement with a surface of the container neck defining the bore. Advantageously the insert may be formed of low density polyethylene (LDPE) and the cap may be formed of high density polyethylene (HDPE). Advantageously the closure may have any of the additional features previously described.

An embodiment of the present invention will now be described by way of example with reference to the accompany drawings in which:

Figure 1 is a perspective view of a container neck and a closure;

Figure 2 is an exploded view of the container neck of Figure 1 and showing the closure to comprise a cap and an insert received within the container neck;

Figure 3 is an exploded view of the container neck of Figure 1 and showing the closure to comprise a cap, an insert and a sealing medium;

Figure 4 is a cross-sectional view of the container neck of Figure 1 with the closure applied to the container neck;

Figure 5 is an enlarged cross-sectional view of a detail of Figure 4;

Figure 6 is a perspective view of an insert forming part of the closure;

Figure 7 is a cross-sectional view of the insert of Figure 6 taken along line VII - VII;

Figure 8 is a cross-sectional view of the insert of Figure 6 taken along line VIII - VIII; and

Figure 9 is a cross-sectional view of an alternative design of container neck and showing an alternative design of cap, the alternative designs of neck and cap cooperating to provide the closure with a tamper-evident capability.

Referring to the accompanying drawings and in particular Figures 4 and 5 there is shown a neck 10 of a container 12, an insert 14 received within the neck 10, and a cap 16 which engages with both the neck 10 and the insert 14. Together, the insert 14 and cap 16 define a closure 18 for the container 12.

The container 12 may be of any conventional design. In particular, the body shape of the container 12 may take any suitable form and may, for example, be of square, rectangular or circular cross-section. Likewise, an integral handle may be formed as part of the body shape.

The profile of the neck 10 is preferably also of a conventional design and may, for example as shown in Figure 9, comprise a pull-up neck finish formed as a result of a blow pin being pulled up through an annular shear steel to create a neck opening having a relatively thin, but generally smooth, annular rim. Alternatively, the neck 10 may comprise a ram-down neck finish formed as a result of a technique in which a blow pin and cutting ring are rammed down through an annular shear steel to produce a neck opening which is surrounded by a much more rigid perimeter and which contains far more plastics material than its pull-up counterpart. As will be readily appreciated by those skilled in the art, the embodiment illustrated in Figures 3 to 5 shows a container 12 having just such a ram-down neck finish as evidenced by the characteristic annular wall which projects upwardly from a radially inner edge of the annular rim and

which is known in the art as a chimney.

The profile of the neck 10 is shown in more detail in Figures 3 to 5 to comprise a radially extending rim 20 which merges, at a radially inner end, with the chimney 22. The chimney 22 is in turn defined by an upwardly extending, radially outer wall 24; an upper, generally horizontal surface 26; and a downwardly extending, radially inner wall 28.

At a radially outer end, the rim 20 merges with a downwardly extending neck stretch portion 30 which is provided, on an exterior surface, with engagement means 32 with which to engage complimentary engagement means provided on the cap 16. In the example shown, the engagement means 32 takes the form of a male helical thread configuration comprising a single start. It will be apparent however, that the engagement means 32 may take a number of different forms and, in particular, may not be limited to a single thread or lead but may comprise two, three, four or more threads as appropriate. For example, the engagement means may comprise five, six, seven or eight threads if so desired. Indeed, although not illustrated, for certain packaging requirements a plurality of threads may be preferable.

In the illustrated embodiment, the single thread extends approximately 450° around the circumference of the neck stretch portion 30. Once again however, it will be understood that threads of a lesser or greater extent may also be employed. For example, in a four start thread configuration, each thread may extend within a range from 90° to more than 360°.

Preferably the helical thread configuration has a fine thread density to limit the vertical float of the cap 16 on the neck 10. Thus, the thread density preferably lies within the range of between 6 and 12 threads per linear inch. Most preferably of all, is a thread density of approximately 8½ threads per linear

inch.

Below the engagement means 32, the neck stretch portion 30 merges with a generally horizontal, radially extending wall 34. This generally horizontal, radially extending wall 34 merges, at a radially outer end, with an arcuate wall portion 36 before in turn merging with a downwardly and radially outwardly extending wall 38. The precise direction and extent of the downwardly and radially outwardly extending wall 38 are determined by the shape of the container 12 which, as stated previously, may be entirely conventional, and forms no part of the present invention.

Irrespective of the neck finish, the container 12 may be blow-moulded from high density polyethylene (HDPE) so as to have a typical wall thickness of between 0.1mm and 1.0mm. A container having a wall thickness of less than 0.1mm is unlikely to have the necessary structural integrity to hold its shape when filled with fluid. For a milk container having a capacity of up to six pints (3.41 litres) a wall thickness of between 0.4mm to 0.6mm is preferred.

The cap 16 which forms part of the closure 18 preferably has a conventional silhouette. In other words, its external dimensions, for example, its height and diameter, are the same as those of existing caps and may therefore be handled using existing capping equipment.

As shown in Figures 4 and 5 the cap 16 comprises a circular top 40 which merges at a radially outer edge with a depending annular side wall 42. The depending annular side wall 42 terminates at an end remote from the circular top 40 in a generally horizontal annular surface 44 while, on an exterior surface, the depending annular side wall 42 is provided with a plurality of circumferentially spaced, vertically extending ribs 46 which serve as knurls to

facilitate the gripping of the cap 16 by a user. In contrast, on a radially inner surface, the depending annular side wall 42 is provided with complimentary engagement means 48 for repeated and releasable engagement with the engagement means 32 provided on the neck 10. As before, this engagement means 48 may take many forms but, in the example shown, comprises a male helical thread configuration having a single start and a thread density of approximately 8½ threads per linear inch. Once again, however, it will be appreciated that the complimentary engagement means 48 need not be limited to a single thread or lead but may comprise two, three or four threads as appropriate. Indeed, the complimentary engagement means 48 may comprise five, six, seven or eight threads if so desired. Indeed, as with the engagement means 32, for some packaging requirements it may be preferable for the complimentary engagement means 48 to comprise a plurality of threads.

In the illustrated embodiment the single thread extends about 450° around the inner surface of the depending annular side wall 42. Once again however, it will be understood that threads of a lesser or greater extent may also be employed. For example, in a four start thread configuration, each thread may extend within a range from 90° to more than 360°.

Likewise, although a thread density of approximately 8½ threads per linear inch is preferred, so as to limit the vertical float of the cap 16 with respect to the neck 10, nonetheless the thread density may differ from this figure. Preferably however, the thread density lies within a range of between 6 and 12 threads per linear inch.

As will be apparent to those skilled in the art, if one of the engagement means 32 or 48 comprises a male helical thread configuration, then the other of the two engagement means may comprise a helical groove

configuration.

The two thread configurations 32 and 48 may be shaped so as to slip past one another and engage when a direct, axial downward force is applied to the cap 16 urging the cap into engagement with the neck 10. In other words, when the cap 16 is pushed onto the neck 10, the thread 48 on the cap snaps over and engages the thread 32 on the neck. This may be made possible by appropriate shaping of the threads 32 and 48, for example, by forming the threads with an asymmetric cross-section or by making them less pronounced. Alternatively, if it is desired to rotate the cap 16 onto the neck 10, the threads may be of symmetrical, as opposed to asymmetrical cross-section and may be more pronounced.

In addition to the complimentary engagement means 48, the interior of the cap 16 is also provided with an annular plug 50 which depends from an undersurface 52 of the circular top 40 and is spaced radially inwardly of the depending annular side wall 42. The annular plug 50 is defined by respective radially inner and outer walls 54 and 56, the radially outer plug wall 56 merging at an end remote from the circular top 52 with a generally downward and radially inwardly directed surface 58. This downwardly and radially inwardly directed surface 58 intersects the radially inner plug wall 54 and, together, serves to provide the annular plug 50 with a bevelled radially outer surface and a tapering cross-section. This tapering cross-section is further accentuated by the fact that, whereas the radially outer plug wall 56 extends in a direction substantially perpendicular to the plane of the undersurface 52, the radially inner plug wall 54 extends from the undersurface 52 in a direction which is both downwardly and radially outwardly.

Elsewhere, as it common with a number of caps, a

small downwardly directed dimple 60 is formed in the centre of the circular top 40 so that any flash left after the cap 16 has been moulded does not project above a plane defined by the upper surface of the circular top 40.

The insert 14 which is received within the neck 10 of the container 12 is defined, in part, by a downwardly extending cylindrical wall 62. At an upper end, the downwardly extending cylindrical wall 62 merges with a radially outwardly extending annular flange 64 while at an opposite, lower, end the downwardly extending cylindrical wall 62 merges with a generally downwardly and radially inwardly directed annular wall 66 of arcuate cross-section. This wall 66 of arcuate cross-section terminates in an upwardly and radially inwardly directed annular surface 68 which would define a circular aperture but for the provision of a membrane 70 which spans the opening defined by the upwardly and radially inwardly directed annular surface 68. The membrane 70 is joined to the generally downwardly and radially inwardly directed annular wall 66 by means of a narrow annular web 72 which interconnects an upper, radially inner corner of the generally downwardly and radially inwardly directed annular wall 66 with a lower, radially outward corner of the membrane 70. As for the membrane 70, it is defined by a substantially horizontally extending outer annular portion 74 which merges with a central, circular, concave portion 76.

A pull-ring 78, defined by an annular band 80, merges with the membrane 70 via a connection 82. The connection 82 merges with the membrane 70 at a location radially inward of, and adjacent to, the annular web 72 such that the pull-ring 78 is joined to the substantially horizontally extending outer annular portion of the membrane 74 as opposed to the central, circular, concave portion 76. The annular band 80 is

sized so as to be located within the insert 14 below the level of the radially outwardly extending annular flange 64 and is provided with radiused upper and lower external surfaces 84 and 86 so as to provide a comfortable surface, devoid of sharp edges, for a user's finger to pull against. The concave nature of the central circular portion of the membrane 76 facilitates the gripping of the pull-ring 78 by creating an increased void below the annular band 80 while, at the same time, reducing the effects of shrinkage on the membrane tear line defined by the narrow annular web 72. As illustrated, the connection 82 between the annular band 80 and the membrane 70 may be strengthened by the provision of a pair of reinforcing gussets 88.

In contrast to the generally downwardly and radially inwardly directed annular wall 66, the radially outwardly extending annular flange 64 provided at an upper end of the downwardly extending cylindrical wall 62 is defined by an upper surface which slopes upwardly and radially outwardly before terminating in an annular pour lip 92. At the same time, a lower surface of the radially outwardly extending annular flange is provided with an annular recess 94 which extends from the radially outer surface of the downwardly extending cylindrical wall 62 and is bound, at an end of the annular flange 64 remote from the cylindrical wall 62, by a downwardly depending annular lip 96.

In order to assemble the closure 18 comprising the insert 14 and cap 16 to the container 12 a sealing medium 98 is applied to the lower surface of the radially outwardly extending annular flange 64 of the insert 14. The sealing medium 98 may be extruded, sprayed, painted or otherwise applied. However, in the preferred embodiment, the sealing medium 98 has sufficient structural integrity to form an annular

ring which can be received within the annular recess 94. For example, the sealing medium 98 may comprise an electrically conductive substrate coated on opposed surfaces with respective first and second layers of an adhesive. The electrically conductive substrate may be formed of any of the materials traditionally used for providing a heat seal in existing plastics containers and may, for example, comprise a metallic foil such as an aluminium foil. Likewise, the layers of adhesive may be of any commercially available type which is capable of bonding with the surrounding plastics material once activated by, for example, the application of heat.

Thus, in this embodiment, the first step in assembling the closure 18 is to assemble the insert 14 and the sealing medium 98. This may be achieved either by inserting the downwardly extending cylindrical wall 62 through the central aperture of the annular ring or else by inverting the insert 14 and pressing the annular ring over the downwardly extending cylindrical wall 62. In either case, the assembly is facilitated by the arcuate cross-section of the generally downwardly and radially inwardly directed annular wall 66. Although in the described embodiment the sealing medium 98 is received within the annular recess 94, nonetheless it is preferably retained in place by means of a friction fit with the radially outer surface of the downwardly extending cylindrical wall 62. Thus the provision of the downwardly depending annular lip 96 is preferably for cosmetic purposes only and serves to conceal the presence of the sealing medium 98 rather than to retain it in position. Indeed, in some embodiments, the downwardly depending annular lip 96 may be omitted.

Having assembled the insert 14 and sealing medium 98, the two are then assembled to the cap 16. The cap

16 is offered up to the insert 14 and, in so doing, the annular plug 50 is received within the blind bore defined by the downwardly extending cylindrical wall 62. The receipt of the annular plug 50 in this way is facilitated by the bevelled nature of the plug as a result of the generally downward and radially inward directed surface 58. Nonetheless, the annular plug 50 is so positioned as to be required to flex radially inwardly in order to be received within the aforementioned blind bore. In this way, once the annular plug 50 has been fully received, the resilience of the material forming the plug causes the radially outer wall 54 to be urged into sealing engagement with the inner surface of the downwardly extending cylindrical wall 62.

It will be noted that the limit to which the annular plug 50 can be received within the blind bore defined by the downwardly extending cylindrical wall 62 is determined by the engagement of the upper surface 90 of the radially outwardly extending annular flange 64 with the undersurface 52 of the circular top 40. However, even in the fully received position, the pull-ring 78 is positioned such that it remains spaced from and does not abut the cap 16.

The closure 18, comprising the insert 14 and cap 16 as well as the sealing medium 98, is now fully assembled. However, all of the components are received within the cap 16 with the result that the external dimensions of the closure 18 are the same as those of the cap 16 which, as stated previously, may be entirely conventional. As a result the assembled closure 18 may be manipulated and applied using conventional processing and capping equipment.

To assemble the closure 18 to the container 12 the container is first filled with the desired contents. Because the container 12 may be of a conventional design, this filling step may be

performed using existing equipment, as may its subsequent processing elsewhere along the production line. Once the container 12 has been filled, the assembled closure 18 is offered up to the neck 10 in such a way that the generally downwardly and radially inwardly directed annular wall 66 of the insert 14 is received within the bore defined by the downwardly extending, radially inner wall 28 of the chimney 22. Continued downward pressure of the closure 18 onto the neck 10 causes the downwardly extending, radially inner wall 28 of the chimney 22 to slide along the radially outer surface of the downwardly extending cylindrical wall 62 until such time as the upper, generally horizontal surface of the chimney 26 engages the sealing medium 98 received within the annular recess 94. In so doing, as the downwardly extending, radially inner wall 28 nears the end of its travel, so the annular plug 50 is once again caused to flex radially inwardly to accommodate both the annular plug 50 and the downwardly extending cylindrical 62 within the bore defined by the chimney 22. As before, the radial inward flexing of the annular plug 50 is facilitated by the generally downward and radially inward directed surface 58 while the resilience of the material forming the annular plug 50 ensures that, afterwards, the annular plug is not only urged into sealing engagement with the inner surface of the downwardly extending cylindrical wall 62 but also that the outer surface of the downwardly extending cylindrical wall 62 is urged into sealing engagement with the downwardly extending, radially inner wall 28 of the chimney 22.

At the same time as the insert 14 is received within the bore defined by the chimney 22, so the depending annular side wall 42 of the cap 16 passes over the downwardly extending neck stretch portion 30. This brings the engagement means 32 into engagement

with the complimentary engagement means 48. As stated previously, these two engagement means 32 and 48 may be shaped so as to slip past one another when a direct, axially downward force is applied to the cap 16 urging the cap into engagement with the neck 10. In other words, as the closure 18 is pushed onto the container 12, so the threads on the cap 16 snap over and engage the threads on the neck 10.

In an alternative embodiment the threads on the cap 16 and the threads on the neck 10 may be shaped so as to require the closure 18 to be rotated onto the container 12. Nonetheless, the downwardly extending cylindrical wall 62 of the insert 14 is still fully received within the bore defined by the downwardly extending, radially inner wall 28 of the chimney 22.

Once the closure 18 has been fully applied to the container 12, the assembled closure and container are exposed to a time varying magnetic field which gives rise to eddy currents within the electrically conductive substrate of the sealing medium 98 with the resultant generation of heat. This heat in turn activates the layers of adhesive and bonds the radially outwardly extending annular flange 64 to the upper, generally horizontal surface 26 of the chimney 22. If necessary, some pressure may be applied to hold the closure 18 firmly against the container 12 during the bonding process.

Although the sealing medium 98 has been described as comprising two layers of a heat-activated adhesive, one on each side of the central electrically conductive substrate, it will be apparent that the insert 14 and neck 10 may nevertheless be permanently bonded together using only a single layer of heat-activated adhesive provided that sufficient adhesive is present within the annular space defined between the cooperating parts of the fitment and neck and provided that the adhesive is capable of flowing into

contact with the surfaces defining that space. To that end, the electrically conductive substrate may be provided with one or more apertures to permit the flow of adhesive from one side of the substrate to the other.

In another embodiment the sealing medium 98 may comprise a sealing compound, and in particular may comprise a pressure adhesion compound such that, upon application of a closing pressure to either the closure 18 or the container 12, the insert 14 is permanently bonded to the neck 10. Alternatively, the sealing medium 98 may be a compound which is activated when exposed to microwave radiation. In yet another currently preferred embodiment, the sealing medium 98 is a composition that permanently bonds the insert 14 to the neck 10 when the sealing compound is softened or melted by inductive and/or capacitive heating. To this end, once the closure 18 has been applied to the container 12, the assembled closure and container are exposed to a time varying magnetic field in the case of inductive heating or a time varying electric field in the case of capacitive heating. In either case, heat is generated within an inductive and/or capacitive material contained within the composition. This heat is then transferred to the rest of the composition and the composition then either softens or melts so that it flows into more intimate contact with the surfaces of the annular space defined between the cooperating parts of the insert and neck structures. Upon cooling, the composition hardens to provide a permanent weld or seal that bonds the insert 14 to the neck 10.

Once the insert 14 has been adhered to the neck 10, the container 12 may be opened by unscrewing and removing the cap 16. This exposes the pull-ring 78 which may be gripped by a finger of the user and pulled. The force imparted to the annular band 80 is

transferred, via connection 82, to the membrane 70 which tears away from the generally downwardly and radially inwardly directed annular wall 66 along the line of weakness defined by the narrow annular web 72. Once the pull-ring 78 and the membrane 70 to which it is attached has been discarded, the contents of the container 12 may be dispensed in the usual way.

To re-close the container 12, the cap 16 is simply presented to the neck 10 in such a way that the helical thread configuration 48 on the cap engages the helical thread configuration 32 on the neck. As the cap 16 is screwed home so the generally downward and radially inward directed surface 58 of the annular plug 50 engages the radially inner surface of the downwardly extending cylindrical wall 62. This causes the annular plug 50 to flex radially inwardly. Once the cap 16 has been fully applied to the neck 10, the resilience of the material forming the annular plug 50 ensures that the radially outer wall of the plug 56 is urged into sealing engagement with a radially inner surface of the downwardly extending cylindrical wall 62 and that a radially outer surface of the downwardly extending cylindrical wall 62 is urged into sealing engagement with the downwardly extending, radially inner wall 28 of the chimney 22.

Because both the insert 14 and cap 16 may be injection moulded and therefore made to the same tolerances, it is anticipated that a reliable reseal may be obtained every time and that, strictly speaking, no secondary seal is required. Nonetheless, a secondary seal may be provided radially outwardly of the chimney 22 at the point of engagement between the upper surface 90 of the radially outwardly extending annular flange 64 and the undersurface 52 of the circular top 40.

The cap 16 may be screwed on and off the neck 10 as many times as is required.

It will be noted that because the sealing medium 98 is located within a space which does not communicate with the interior of the container 12 there is little risk of the sealing medium tainting or otherwise affecting the contents of the container. Likewise, because the insert 14 is provided with a downwardly extending cylindrical wall 62 which sealingly engages against the downwardly extending, radially inner wall 28 of the chimney 22, there is little likelihood of the contents of the container leaking out past the sealing medium 98 between the insert 14 and the neck 10.

It will also be noted that because both the effective size of the container opening (defined by the diameter of the upwardly and radially inwardly directed annular surface 68) and the annular pour lip 92 are both defined by the same injection moulded component, the relationship between the two can be optimised so as provide the optimum pouring angle whilst retaining a practical bore.

Whilst the application of the closure 18 has been described with reference to a ram-down neck finish, it will be understood that the present invention may also be applied to a pull-up neck finish. Indeed, the only difference between the two resides in the fact that, in the absence of the chimney 22, the sealing medium 98 serves to bond the underside of the radially outwardly extending annular flange 64 to the radially extending rim 20 rather than to the upper, generally horizontal surface 26. Nonetheless, the downwardly extending cylindrical wall 62 can still be received within the bore defined by the radially extending rim 20 where, as before, it will be in sealing engagement with both the radially extending rim 20 and the annular plug 50. Thus, in all material respects the closure 18 may be applied, opened and resealed to a ram-down neck finish as described above. In

particular, it will be noted that, notwithstanding the absence of the chimney 22, the sealing medium 98 is still contained within an annular space which does not communicate with the interior of the container 12.

With containers having either a pull-up or ram-down neck finish the provision of the downwardly depending annular lip 96 serves to conceal the presence of a sealing medium 98.

Although in the embodiment described the closure 18 has not been provided with any tamper evidence capability, it will be understood that this could also be provided. Indeed, since one of the advantages of the present invention is that it may find use with conventional containers 12 and makes use of caps 16 having a conventional silhouette, if those conventional containers and caps incorporate tamper evidence means, then so to may the present invention. One such example is illustrated in Figure 9.

Although the engagement means 32 provided on the neck 10 and the complimentary engagement means 48 provided on the cap 16 have been described in terms of a helical thread or groove configuration, nonetheless the two sets of engagement means 32 and 48 may simply comprise a snap-band and cooperating retaining bead. Alternatively, the engagement means 32, 48 may rely upon nothing more than a friction or interference fit. Under such circumstances the resulting cap may be presented as a push-on cap rather than of the screw-on variety.